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P01/7700 0.00-0217268.2

The Patent Office

23 JUL 2002

Cardiff Road
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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1. Your reference

PA/GX02

2. Patent application number
(The Patent Office will fill in this part)

0217268.2

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

DAVID EDWARD CROSS
HEDGE END, HURST ROAD,
EAST PRESTON, LITTLEHAMPTON,
WEST SUSSEX BN16 3AP

Patents ADP number *(if you know it)*

1105930002

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

ELECTROCHEMICAL CELLS

5. Name of your agent *(if you have one)*

GRAHAM F COLES

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

GRAHAM COLES & CO
24 SEELEYS ROAD
BEACONSFIELD
BUCKINGHAMSHIRE
HP9 1SZ

Patents ADP number *(if you know it)*

4361556001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

NO

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	5
Claim(s)	
Abstract	
Drawing(s)	1 + 1

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date 22-07-02

12. Name and daytime telephone number of person to contact in the United Kingdom GRAHAM F COLES ☎ 01494 677181

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

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Electrochemical Cells

This invention relates to electrochemical cells.

The invention is particularly, though not exclusively, concerned with electrochemical cells of the kind used for purification of water and the production of disinfecting aqueous solutions. Electrochemical cells of this kind have been proposed in which a porous ceramic membrane is interposed between coaxial electrodes, and it is one of the object of the present invention to provide an improved form of such a cell.

According to one aspect of the invention there is provided an electrochemical cell in which an inner cylindrical electrode extends coaxially within a porous tube that is mounted coaxially within a hollow, cylindrical outer electrode to define inner and outer annular passageways between the respective electrodes and the tube for liquid-flow lengthwise of them from one to the other of cup-shape fittings at either end of the cell each of which incorporates two inlet/outlet ports communicating with the inner and outer passageways respectively, wherein each cup-shape fitting defines a cylindrical cavity which has an open-mouth that is of a diameter to receive a respective end of the outer electrode for liquid-tight sealing therewith, the porous tube at each end of the cell projects from within the outer electrode into said cavity of the fitting at that end and has an annular rim for engagement with an internal cylindrical wall of the cavity for liquid-tight sealing therewith to separate the inner and outer passageways from one another within the fitting, and the inner electrode projects at each end of the cell from the porous tube into the cavity of the fitting at that end.

The outer electrode may be a metal tube, and the inner electrode a metal rod. Whichever electrode is used as the cathode may be of titanium or stainless steel, whereas that used as the anode may be of titanium and may have a coating (for example, of ruthenium and iridium oxides) that acts as a catalyst in the electrochemical action of the cell.

The porous tube may be of a ceramic (for example, composed of aluminium, zirconium and yttrium oxides) and the annular rim at each of its ends may be slidable within the cavity, and may be provided by a flange of a member sealed or otherwise secured to the porous tube at that end. The extent to which the porous tube can slide relative to the outer and inner electrodes may be limited at each end by abutment of the tube-end there with a part (for example, a pin or annular rim) that projects laterally into the cavity, or abutment of a longitudinal projection from the tube-end with the bottom of the cavity or of a longitudinal projection from the bottom of the cavity with the tube-end.

The cavity of each cup-shape fitting may have a stepped internal diameter for defining a first cavity-part leading from the open mouth and a second cavity-part of smaller diameter opening from the first cavity-part. In these circumstances, the porous tube at each end of the cell may project from within the outer electrode into the first cavity-part of the fitting at that end to have its annular rim engage with the internal cylindrical wall of the first cavity-part, and the inlet/outlet ports of each fitting may open into/from the first and second cavity-parts respectively.

An electrochemical cell in accordance with the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a part sectional side-elevation of the electrochemical cell according to the invention; and

Figure 2 is an enlarged sectional side-elevation of one end of the electrochemical cell of Figure 1.

Referring to Figures 1 and 2, the inner and outer electrodes of the electrochemical cell are formed by a coaxial rod 1 and tube 2 respectively. The rod 1 and tube 2 are of titanium and the inside surface of the tube 2, which is to act as the anode, is coated with ruthenium and iridium oxides that provide a catalyst in the electrochemical action of the cell. A ceramic tube 3 composed of aluminium, zirconium and yttrium oxides, is supported coaxially between the rod 1 and tube 2 to provide an intermediate porous membrane for separating the products derived electrochemically at the two electrodes. More particularly, the tube 3 divides the space between the rod 1 and tube 2 into two coaxial, annular passageways 4 and 5 for liquid-flow lengthwise of the electrodes formed by the rod 1 and tube 2.

The passageways 4 and 5 terminate at either end of the cell in sideways-extended inlet/outlet ports 6 and 7, respectively, of individual one-piece plastics fittings 8 (for example, of polypropylene) that are retained on opposite ends 9 of the rod 1. Each fitting 8 is of cup-shape with a stepped internal diameter that defines a first cylindrical cavity-part 10 into/from which the port 7 opens, and which leads via an annular end-face 11 (Figure 2) into a second cylindrical cavity-part 12 of smaller diameter into/from which the port 6 opens. The ends 13 of the tube 2 are lightly machined externally over a short length (for example, 5 mm) so as to enable them to be received and provide liquid-tight sealing, in recessed mouths 14 (Figure 2) of the cavity-parts 10 of the fittings 8.

The rod 1, on the other hand, extends axially through both cavity-parts 10 and 12 of each fitting 8, and has ends 9 of reduced diameter. The end 9 within each fitting 8 projects from the cavity-part 12 into and through a bore 15 of the fitting 8. It is a liquid-tight interference fit within the bore 15 (it may be lightly machined over a length of, for example, 5 mm, to ensure a constant diameter for the purpose), and is screw-threaded to receive a nut 16 (only one shown) where it projects from the fitting 8. The nuts 16 are tightened to clamp the fittings 8 firmly onto the two ends 13 of the tube 2 and hold them to the rod 1 with the rod 1 and tube 2 coaxial with one another.

The tube 3, which projects beyond the ends 13 of the tube 2 within the cavity-part 10, has a radial rim or flange 17 (Figure 2) at each end. Each flange 17 is part of a plastics tubular moulding 18 which is retained on the tube 3 by a plastics sleeve 19 that is heat-shrunk onto the respective end of the tube 3. It provides a liquid-tight, sliding fit within the internal cylindrical wall of the respective cavity-part 10, separating the passageways 4 and 5 from one another within the fitting 8 at that end.

More especially, the extent of projection of the tube 3 beyond the end 13 of the tube 2 within each fitting 8 ensures that the flange 17 is located deeper within the cavity-part 10 than the port 7 so that it maintains appropriate separation of the port 7 from the cavity-part 12 and port 6. The integrity of this separation is maintained since the freedom of the tube 3 to slide relative to the tube 2 is limited to a small distance (for example, 1 to 2 mm) by the walls 11 at both ends of the cell. However, the freedom for sliding ensures that the clamping forces exerted by the nuts 16 clamping the fittings 8 to the ends 13 of the tube 2 and holding them

on the ends 9 of the rod 1, are not exerted on the tube 3. The fact that the somewhat-fragile, ceramic tube 3 is not subject to any clamping force avoids the need to cushion it resiliently.

The attachment of the mouldings 18 to the tube 3 may be by adhesive instead of the heat-shrunk sleeves 19, or by bonding them on by heating the ends of the tube 3 so that the plastics is partially melted as the mouldings 18 are pushed on.

The form of construction of the electrochemical cell described above, has significant advantages of simplicity and economy in that the number of components is reduced as compared with earlier forms, and the extent of machining required is light and limited to the ends 9 of the rod 1 and the ends 13 of the tube 2. Moreover, stock material may be used for the electrodes (for example seam-welded tubing may be used for the tube 2), and the porous ceramic tube 3, which for example, may have a porosity between 50% and 70% with a pore size of between 0.3 and 0.5 microns, is not required to withstand compressional forces or satisfy tight dimensional tolerance-limits. The flanges 17 of the mouldings 18 attached to the ends of the tube 3 provide both the sliding freedom and the liquid-tight sealing required, in a simple manner without any strict dimensional requirement on the tube-diameters.

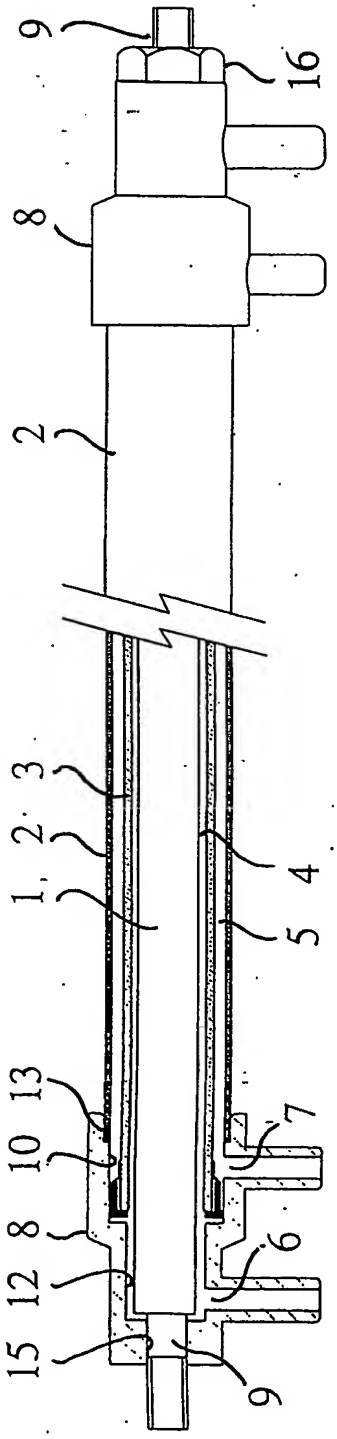

Fig. 1

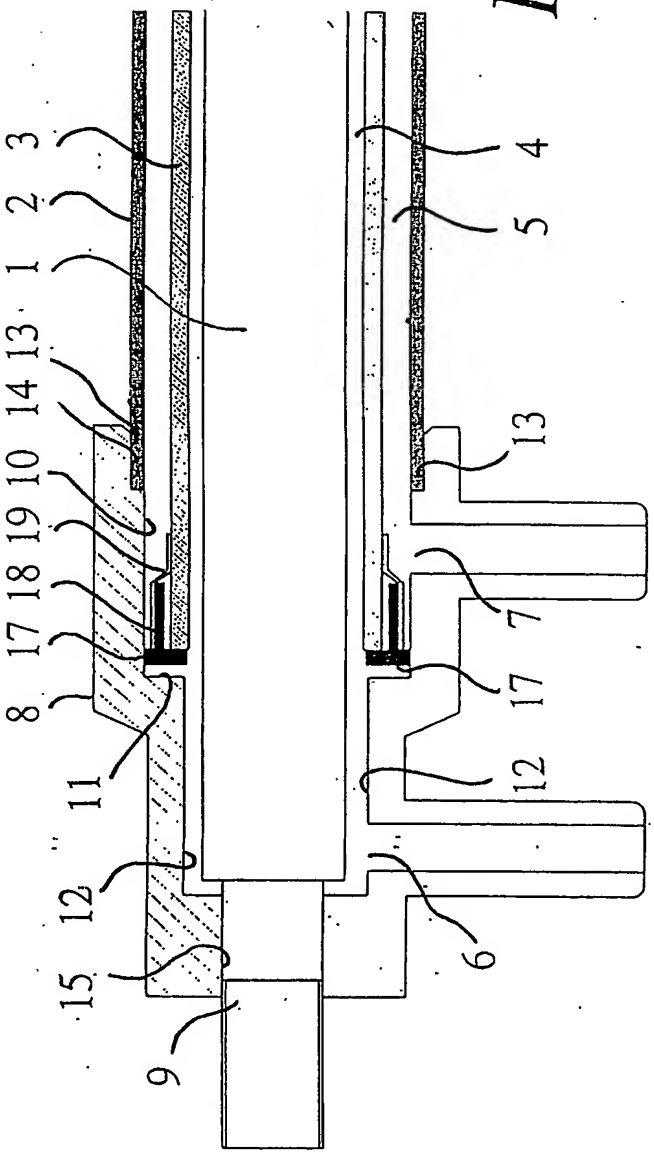

Fig. 2